

High Efficiency Troffer Performance Specification

Version: 5.0

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Summary

The U.S. Department of Energy's (DOE) Better Buildings Alliance (BBA) has developed this specification for the performance characteristics of high-efficiency lighting troffers. The purpose of the specification is to provide a description of requirements that will result in energy savings for troffers, reliable performance, and energy cost savings. It also includes options for additional requirements such as emergency lighting, dimming, and controls. This specification was developed through collaboration with Better Buildings Alliance Lighting & Electrical Team members and with input from manufacturers and other interested parties.

This specification defines the photometric and colorimetric performance characteristics for a product that is in the top efficiency tier – which is considered approximately less than the top 10% of the current market. The specification can be used in a request -for-proposal by copying the language on the following pages.

DOE and BBA are promoting this specification because half of all commercial fluorescent lighting fixtures are troffers. With operating hours of 10+ hours per day – troffers collectively consume nearly 97 billion kilowatt-hours (kWh) of electricity annually, worth approximately 9.9 billion dollars; this is as much energy as 8.9 million homes consume in a year. By adopting this specification for troffers, building owners can save 30-60% on a one-for-one basis and up to 75% with controls. If all troffers in the nation complied with this specification, the nation could save approximately 39 billion kilowatt-hours (kWh) of electricity annually, worth approximately 4 billion dollars

Additional information on the DOE and BBA activities, including other energy saving purchase specifications and demonstration case studies can be found on the BBA website (<http://eere.energy.gov/BetterBuildingsAlliance>)

Specification requirements start on the next page. The cover page and summary should not be submitted to the manufacturer.

1.1 Scope

- I. **This specification applies to high efficiency troffers that meet all of the following criteria:**
 - a. Nominal dimensions:
 - i. 1'x4" – width = 12", length = 48"
 - ii. 2'x2" – width = 24", length = 24"
 - iii. 2'x4" – width = 24", length = 48"
 - b. Maximum height (depth) = 5"
 - c. Mounting
 - i. Recessed
 - ii. Surface-mounted

1.2 Standards

- I. **American National Standards Institute:**
 - a. ANSI C78.376-2001, Specifications for the Chromaticity of Fluorescent Lamps
 - b. ANSI/NEMA/ANSI C78.377-2011, Specifications for the Chromaticity of Solid State Lighting (SSL) Products
- II. **Illuminating Engineering Society of North America:**
 - a. IES LM-9-09, Approved Method: Electrical and Photometric Measurements of Fluorescent Lamps
 - b. IES LM-41-14, Approved Method: Photometric Testing of Indoor Fluorescent Luminaires
 - c. IES LM-79-08, Approved Method: Electrical and Photometric Measurements of Solid-State Lighting Products
 - d. IES LM-80-08, Approved Method: Measuring Lumen Maintenance of LED Light Sources
 - e. IES TM-21-11, Projecting Long Term Lumen Maintenance of LED Light Sources
- III. **UL:**
 - a. ANSI/UL 1598-08 NMX-J-307/1-ANCE/C22.2 NO.250.0-08, Luminaires
 - b. ANSI/UL 8750-2009, Standard for Light Emitting Diode (LED) Equipment for Use in Lighting Products

1.3 Application

- I. **Ceiling Application and types**
 - a. F (Flanged)
 - b. M (Modular) and Z (Z Spline)
 - c. G (Grid)
 - d. SS (Screw Slot)
 - e. Plaster Frame Kit
- II. **Construction / Finish**
 - a. No visible welding, no plane-protruding screws, latches, springs, hooks, rivets or plastic supports viewed from the occupied (room) side are allowed.
 - b. Air-handling capability (optional)
 - c. Recessed, Type IC (intended for insulation contact) (optional)
 - d. Earthquake clips (optional)
 - e. NYC electrical code compliant (optional)
 - f. Chicago electrical code compliant (optional)
- III. **Maintenance**
 - a. Power supplies/drivers/ballasts, LED arrays, boards or light engines shall be easily field replaceable using common hand tools (e.g., screwdrivers, pliers, etc.) and without uninstalling the luminaire

1.4 Electrical and Photometric Requirements

I. Electrical

- a. Operating voltage: 24 Vdc, 120 Vac at 60 Hz, 277 Vac at 60Hz, or universal voltage (120, 220/240, 277 Vac at 50/60 Hz)
- b. Power factor: ≥ 0.90 (at full luminaire output and across specified voltage range)
- c. Total harmonic distortion: $\leq 20\%$ (at full luminaire output and across specified voltage range)
- d. Transient and surge protection: ANSI C62.41-2002 Category A surge protection standards up to and including 2.5 kV
- e. Sound: Class A not to exceed a measured value of 24dB
- f. Maximum standby power: 1W
- g. Warranty: 10 years on equipment
- h. LED arrays in the product(s) will be considered defective in material or workmanship if a total of 10% or more of the individual light-emitting diodes in the product(s) fail to illuminate during normal operation after installation.
- i. LED Power Supply/Driver
 - i. Driver efficiency (at full load):
 - ii. $\geq 85\%$ for drivers capable of ≥ 50 watts
 - iii. $\geq 80\%$ for drivers capable of < 50 watts
 - iv. Federal Communications Commission (FCC) compliance: FCC 47 Part 15 Non-Consumer limits for EMI/RFI emissions
- j. Fluorescent Ballast
 - i. Output frequency $\geq 40\text{kHz}$
 - ii. Lamp current crest factor: ≤ 1.7
 - iii. Minimum lamp starting temperature: 50°F (10°C) at full light output. 60°F (15°C) at 50% or lower dimming
 - iv. Ballast Luminous Efficiency (BLE)
 - 1. 1 lamp ≥ 0.83
 - 2. 2, 3 or 4 lamp ≥ 0.86
 - v. Federal Communications Commission (FCC) compliance: FCC 47 Part 18 Non-Consumer limits for EMI/RFI emissions
 - vi. ROHS 2 (Directive EC 2011/65)
 - vii. Inrush current: ANSI C82.11-2011 section 5.121
 - viii. End-of-lamp-life protection for T5 and smaller lamps

II. Photometric & Colorimetric Performance

a. Photometric

1. Minimum initial delivered luminaire lumens
 - a. 1'x4' - 1,500 initial lumens
 - b. 2'x2' - 2,000 initial lumens
 - c. 2'x4' - 3,000 initial lumens
2. Minimum Luminaire Efficacy (LE) or Luminaire Efficacy Rating (LER) :
 - a. 1'x4', 2'x2' and 2'x4' – 110 lm/W
3. Spacing criteria (SC): The ratio of center-to-center fixture spacing to mounting height (ceiling-to-work plane)

	0° – 180° Plane	90° – 270° Plane
1'x4', 2'x2', and 2'x4'	1.0 – 2.0	1.0 – 2.0

b. Colorimetric

- i. Correlated Color Temperature (CCT): Only allowed CCTs are 2700K, 3000K, 3500K, 4000/4100K, 4500K and 5000K
- ii. Acceptable tolerances as provided in ANSI C78.376-2001 (fluorescent)
- iii. Acceptable tolerances as provided in ANSI C78.377-2011 (LED)
- iv. Color Rendering Index (CRI) $[R_a] \geq 80$ with a positive R_9 value
- v. Color shift of no less than $\Delta u''v'' < 0.007$ during the warranty period

c. Life

- i. Minimum rated life of 68,000 hours
 - a. For LED defined as L_{70}
 - b. For fluorescent lamps based on a 12-hour start with an instant start ballast

1.5 Options

- I. Emergency lighting**
 - a. Emergency battery pack available factory or field installed
- II. Dimming**
 - a. Manufacturers shall provide listing of compatible dimmers that have been tested to conform to at least one of the dimming protocols listed below and approved for use with their products
 - b. Dimming protocols and performance expectations
 - i. No phase-cut dimming
 - ii. Step dimming from 100% to at least one preset level between 70% and 10%
 - iii. Continuous, flicker-free dimming from 100% to 5%
 - iv. DALI, DMX/RDM, ZigBee, and EnOcean
- III. Integrated Controls (optional)**
 - a. Sensors
 - i. Dual-tech (passive-infrared and ultrasonic) occupancy sensor that can be used either as an occupancy sensor or a vacancy sensor
 - ii. Sensor coverage must be at least 140 square feet assuming an 8' mounting height
 - b. Daylight or ambient lighting sensor
 - c. Constant lumen management
 - d. Load shedding/demand response
- IV. Centralized power conversion/controls/metering**
 - a. Power conversion
 - i. System shall have centralized power conversion from high voltage AC to low voltage DC
 - ii. Capable of powering a minimum of four discrete luminaires
 - b. Controls/metering
 - i. Standby power draw: <10W at the central power supply
 - ii. Contains ambient temperature sensor(s)
 - iii. Contains fixture current and voltage sensor for integrated power metering
 - iv. Field-upgradeable for new fixture types or future sensor package upgrades and modifications

